

REMARKS

Claims 1-11 are pending in the application for the Examiner's review and consideration. Claim 1 has been amended to correct a typographical error and to clarify that the instant method involves a nucleation step (A) that precedes the deposition step (B). Support for the changes to Claim 1 can be found in the specification at page 5, lines 3-32. As no new matter has been introduced by these changes, they should be entered at this time. Favorable consideration and allowance are respectfully requested for Claims 1-11 in view of the foregoing amendments and the following remarks.

The rejection of Claims 1-11 as allegedly obvious over U.S. Patent No. 4,619,840 to Goldman et al. ("Goldman") is respectfully traversed. The reasons for the rejection are set forth beginning at page 2 of the Office Action. Specifically, the Office Action alleges that it would have been obvious to withhold a critical process parameter with the expectation of avoiding deposition at the times when deposition is not required.

Claim 1 recites a method of forming a metal film from a metal carbonyl compound source. According to Claim 1, the method requires a **first step** of introducing a metal carbonyl compound at a first partial pressure such that nuclei form on a substrate without causing substantial deposition of a metal film on the substrate. The method further requires a **second step** of introducing a

metal carbonyl compound at a second, lower partial pressure in order to deposit a metal film on a surface of the substrate.

As set forth from page 4, line 27-page 5, line 2 of the specification, the method can be used to form a high quality metal film at a substrate temperature that is compatible with low-k materials. Further, the method advantageously involves minimal incubation time. For example, as recited at page 19, lines 18-22, by using the two-step method of the invention, the incubation time can be eliminated. In contrast, when a nucleation step is not provided, an incubation time of as much as 400 seconds is incurred.

To establish a *prima facie* case of obviousness, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). In the present case, Goldman merely teaches a metal CVD process using a carbonyl source. There is no suggestion to include a nucleation step in the process of Goldman. Goldman does suggest withholding a critical process parameter to avoid deposition when deposition is not required, as asserted in the Office Action. For example, as disclosed by Goldman, after the deposition of a tungsten film is carried out, a plug valve 98 is closed to stop the flow of tungsten carbonyl and stop the deposition. Thus, the metal carbonyl compound is withheld by Goldman in order to terminate the process. The flow of nitrogen is also terminated (see Goldman at column 7, lines 19-28).

However, the Office Action has not set forth any tenable basis as to why one would include a nucleation step in the process of Goldman, much less a nucleation step comprising introducing a metal carbonyl compound at a first partial pressure that is higher than a second partial pressure used during a deposition step. As clearly set forth in the specification, the first step is not provided merely to suppress deposition of a metal film, but to form crystal nuclei that, together with the second step, facilitate the formation of a high quality metal film at low substrate temperatures with minimal incubation time. Goldman is completely silent as to a two-step method. Nothing in Goldman suggests conducting a first (nucleation) step followed by a second (deposition) step at a second, lower partial pressure of a metal carbonyl compound. Accordingly, withdrawal of the rejection of Claim 1 is respectfully requested. Further, Claims 2-11 depend from Claim 1 and thus are patentable over Goldman for at least the reasons that Claim 1 is patentable.

Claims 1-11 were rejected under the judicially-created doctrine of obviousness-type double patenting over Claims 1-53 of commonly-owned U.S. Patent No. 6,924,223 to Yamasaki et al. ("Yamasaki"). This rejection is respectfully traversed.

As discussed above, Claim 1 of the instant invention relates to a two-step method of forming a metal film. Claim 1 requires a first step wherein a metal carbonyl compound is introduced at a first partial pressure and a second step

wherein a metal carbonyl compound is introduced at a second, lower partial pressure. During the first step, nuclei are formed on the substrate without causing substantial deposition. During the second step, a metal film is deposited on a surface of a substrate.

Claim 1 of Yamasaki recites a method of forming a metal layer on a substrate, the method comprising (i) providing a substrate in a process chamber; (ii) exposing the substrate to a reducing gas at a substantially constant flow rate; (iii) exposing the substrate to a purge gas at a substantially constant flow rate; (iv) exposing the substrate to a pulse of a metal-carbonyl precursor, thereby forming a metal layer on the substrate; and (v) repeating the exposing processes until a metal layer with a desired thickness is formed. Dependent Claim 33 of Yamasaki recites the additional limitation of depositing a metal nucleation layer on the substrate.

However, while Yamasaki does disclose that dilution gases can be used to adjust the partial pressure of the process gas (see column 3, lines 57-60), Yamasaki does not disclose or suggest a nucleation step that is performed by introducing a metal carbonyl precursor at a first partial pressure that is higher than a second partial pressure used during a subsequent deposition step. Because the claims of Yamasaki are patentably distinct from the instant claims, withdrawal of the rejection is respectfully requested.


It is submitted that the difference between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to person having ordinary skill in the art. In view of the foregoing, the application is respectfully submitted to be in condition for allowance, and prompt favorable action thereon is earnestly solicited.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #010986.52586US).

Respectfully submitted,

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